Forest Health Protection

Report 04-15 **November 2004**

Weitas Creek Campground, Clearwater National Forest

August 2004

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SUMMARY

The Weitas site has been used as a campground for at least several decades. In fact there is some evidence that the site may have been used by indigenous people before recorded history. It continued to be a popular campground until the decision was made in 2000 to close the area to camping until the problem of hazardous trees could be dealt with.

Conversion of the site from western redcedar to grand fir and subsequent maturation of the grand fir, have lead to a serious root disease situation. Annosus root disease (*Heterobasidion annosum*), accompanied by fir engraver beetle (*Scolytus ventralis*), is the primary cause of tree death. These trees are especially hazardous because both roots and stems are compromised and either structure is likely to fail in both live and dead trees.

The campground borders both the North Fork of the Clearwater River and Weitas Creek and is accessed using the Weitas Creek bridge connecting forest roads 105 and 105A. Protection of the riparian zone along the river and creek is among the stated objectives of this assessment. In addition to standard hazard tree evaluation, we looked for opportunities to minimize the necessity for hazard tree removal within the riparian protection zone.

We mapped and measured a total of 917 trees in Weitas campground area. In the area between the 105A road and the riparian zone (the actual camping sites), 487 trees were mapped and measured. An additional 215 trees in the riparian zone were mapped and diameters were estimated. In the “adjacent zone” above, and within 150 feet of, the 105A road trees that were recommended for retention were measured and evaluated for root disease but not mapped. There were 215 trees included in this tally.

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In the riparian protection zone, 8 percent of trees (17 trees) were recommended for removal as hazard trees, 6 of these were dead. In the camping area between the riparian protection zone and the 105A road, 57 percent were recommended for removal, 17 percent of these were dead.

Where possible, clusters of trees were identified for retention to minimize the adverse effects of tree cutting on the site. The treatment will not significantly reduce the likelihood of root disease causing the death of remaining trees. Root disease mortality will be an ongoing source of hazard trees in Weitas campground as long as grand fir or Douglas-fir is present.

GENERAL CONDITION OF TREES IN THE CAMPGROUND

The campground has been used informally for several decades and a few physical improvements have been provided. Five of the sites have been provided with permanent tables and fire rings. There are two outhouses. The remainder of the campground shows evidence of informal fire rings, parking and tent sites. Trees throughout the campground, regardless of current campsite locations, were assessed and mapped to accommodate development of a formal campground plan.

The Weitas site had been dominated by very large western redcedar in the 1920's as evidenced in stumps found throughout the campground and surrounding area. Following harvest of the cedar tress in the 1930's, grand fir developed as the primary species (figure 1).

Figure 1: Cedar stumps are dispersed in the mostly grand fir forest in the campground and surrounding area.

Today, there are few trees of any species other than grand fir. The forest in Weitas campground is mid seral with grand fir making up 93 percent of the mature tree component as well as roughly 90 percent of the younger age classes. Western redcedar comprised 3 percent of the trees measured and Douglas-fir were less than 2 percent. The trees are mostly about 60 years of age. They are dense in some parts of the campground. A distinct, large, old root disease center dominates the area near the center of the campground, adjacent to the outhouses. Tree death is common throughout the campground and tree root failures are in evidence in several places (figure 2). Fresh annosus conks were collected from hollow stumps in unit 5 near the outhouses (figure 3).

Figure 2. Root decayed by *H. annosum* was the probable cause of this tree failure.

Figure 3. *Heterobasidion annosum* was found in this hollow stump near the table in Unit 5.

The disease, primarily annosus root disease (*Heterobasidion annosum*), is naturally occurring in the grand fir and is seen throughout the campground and surrounding area. The disease is progressive and has become severe in many trees and groups of trees (See Appendix A: Annosus Root Disease). Most show signs of decline, and some are dead (Figure 4). Thin crowns with branch dieback for most of the length of the crown, are typical symptoms of progressive dieback of grand fir caused by *H. annosum*. Many of the grand fir had signs of advanced heartrot caused by Indian paint fungus (*Echinodontium tinctorium*). A few older dead trees had been attacked by fir engraver beetles and some live trees were currently being attacked by the beetles.

Figure 4. Crown symptoms of annosus root disease in Weitas Campground

ASSESSMENT METHODS

Three distinct zones in the campground were assessed using differing methods according to the objectives for each zone.

Camping area between 105A road and riparian zone: We assessed the condition of all trees greater than 4 inches at breast height that were in the area between the 105A road and the riparian zone along the river and creek. As planning progresses, many of the existing units may be moved and additional units may be developed. Therefore, we mapped and measured all trees in the potential camping area rather than restrict the assessment to trees with known targets.

Riparian protection zone: Trees within 75 feet of the North Fork River upstream from the bridge were mapped and their diameters were estimated to the nearest 5 inches. The slope break was used to designate trees as within or outside of the riparian protection zone downstream of the bridge and on Weitas Cr. For the most part, this extended the riparian zone considerably beyond 75 feet from the river. The exception was in the camp site designated unit 1, adjacent to the bridge. The unit 1 table and fire ring are within 75 feet of the river.

Above 105A road, within 150 feet of the road: Trees in this zone are generally close enough to require evaluation as a hazard to travelers on the 105A road. We opted to tally only those trees which we recommended for retention. They are distributed throughout the area above the road and will provide a reasonable estimate of the stocking after hazard tree removal.

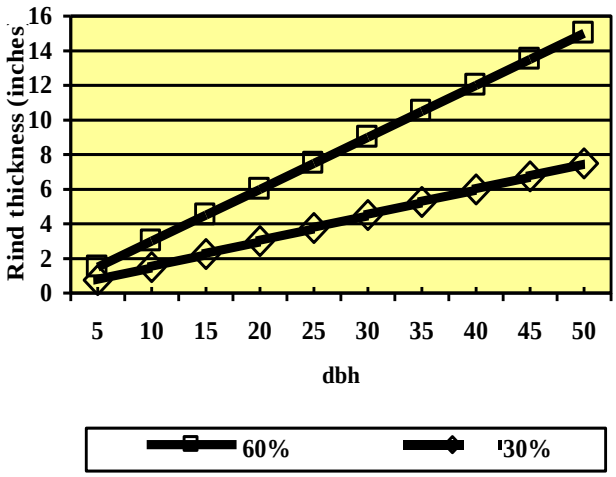
Mapping and scoring trees

We developed 25 maps to cover the campground area between the main road and the North Fork River and Weitas Creek. Map blanks were used, which divided the site into quadrants beginning with true north aspect and proceeding clockwise around the fire ring, or other central map feature. Distance to at least two trees on each map was recorded to calibrate the map scale.

Species and diameter at breast height was recorded for each tree. They were scored for all significant damages and defects observed using six standard damage categories (Appendix B); decay, wound, canker, lean or sweep, branch or forking defects, root damage or disease. For each of these categories a severity range of 1-4 was applied, to make a combined code such as D3 (decay, severity level 3).

Where heartwood decay was suspected, trees were bored to determine the depth of sound rind. Trees with sound rind (outer xylem of the stem) depth of at least 60 percent of the radius of the stem are considered to be low hazard for failure due to the heartwood decay. Those with 60% to 30 percent sound rind are considered moderate hazard, and those with less than 30 percent have a relatively high probability of failure. Therefore we used the graph in figure 5 to determine the severity rating for trees with heartrot.

Figure 5. Thickness of sound rind based on 30% and 60% of radius (inside bark).



Root damage ratings were used to indicate trees with root disease symptoms. A rating of R3 indicated trees with significantly deteriorated crown condition, presumably due to root disease. R4 indicated trees that were in the final stages of dying from root disease. Root damage ratings of 1 and 2 were used to indicate physical damages (wounding and severing).

Wounds, largely human-caused, were common in some sites. Wounds, leans and dead tops were scored according to the table in Appendix B.

Determining targets

Many trees had more than one potential target. Standard target codes were as follows: 1 = occasional use such as trails or signs with no vehicle access (this code was not used in this assessment); 2 = intermittent use such as busy trails, the campground road and entry and day use areas; 3 = frequent use such as campsites, parking areas and permanent structures. Trees with more than one target were assigned the highest code applicable. The exception was in the case of a lean value of 3 or higher. If the tree was leaning strongly away from the highest rated potential target, it was assigned the rating of the more likely target.

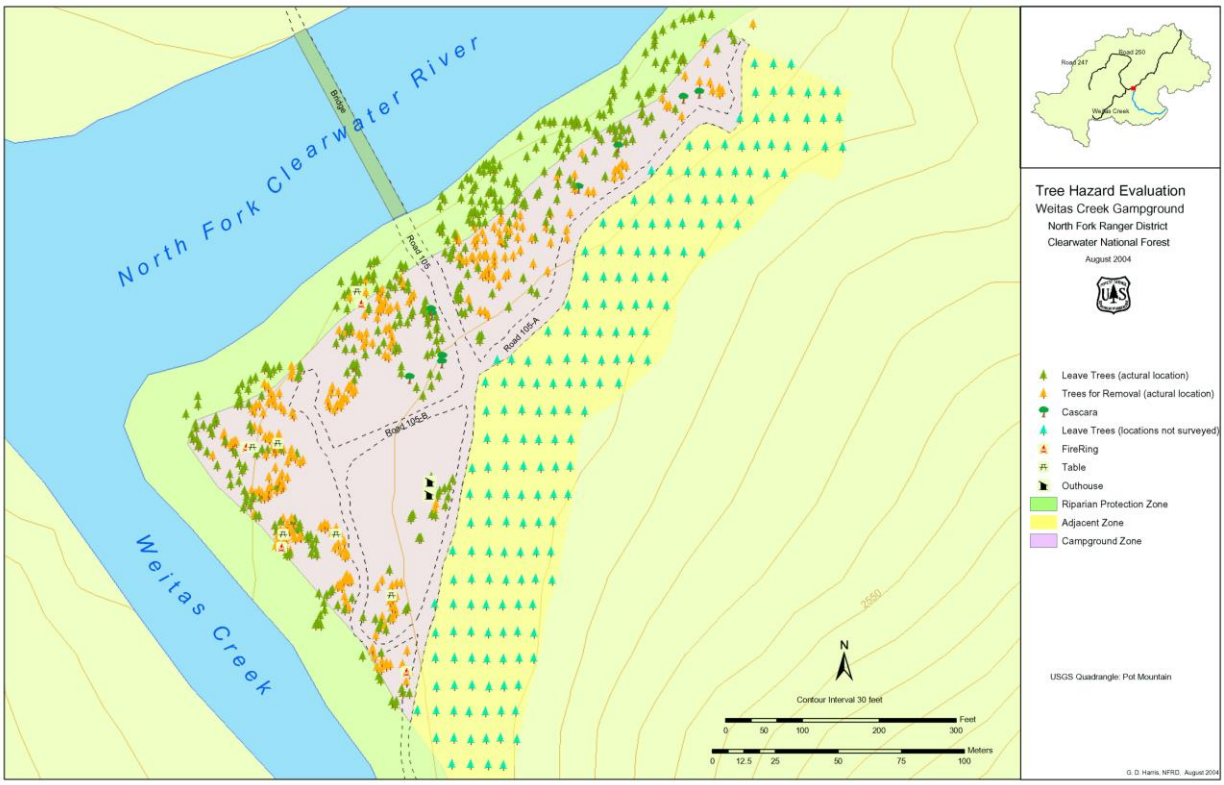
Action recommendations

Many grand fir trees with advanced root disease or heartrot symptoms or signs, especially those near or leaning toward developed targets were designated for removal. Recommendation for removal was usually based on the probability of eminent death due to root disease or an unreasonably high probability of failure due to advanced heartrot or butt rot. A combination of moderate root disease and a lean toward a class 3 target, root disease combined with moderate heartrot (and a class 3 target) or similar combinations of conditions resulted in a recommendation for removal. Trees thus identified were painted with orange paint at breast height.

Most trees recommended for removal already had been identified and painted when the hazard trees were previously marked by a District crew. We recorded trees for which we changed the original marking. Trees that are marked for removal and then identified in this survey for retention were flagged. These trees were later un-marked (by painting over the orange with gray-brown paint to blend with the bark color).

Data handling

Data were recorded on field sheets and entered into a Microsoft Excel sheet for analysis using Microsoft Access. The maps were digitized for display using ArcMap and incorporated into a GIS database creating a UTM coordinate for each tree. GPS locations of map center points and azimuths and distances between center points allowed accurate mapping of trees throughout the campground area (see map below). Precise azimuths and distances were not measured for all trees, therefore, some tree map locations were adjusted based on tree crown positions shown on a digital orthophoto. Both the database and maps should be easily updated from these products for future assessments of Weitas Cr. Campground. If kept current, they should provide for easy tracking of campground trees in the future.



RESULTS OF THE ASSESSMENT

We assessed 917 trees in all (Table 1). Of these, 702 were mapped on 24 stem maps. Six of these were centered on improved campsites (with fire rings and picnic tables. The remaining 215, which were identified as retention-trees in the 150 ft strip above the main road, were measured and evaluated for root disease severity.

Table 1. Tree condition and average diameter at breast height by species of all trees evaluated in Weitas campground and surrounding area. (Based on July 2004 assessment.)

Species	Total	Dead	Average d.b.h.
Grand fir	855	53	14.9
Western redcedar	28	0	10.1
Douglas-fir	18	1	11.7
Western white pine	5	0	14.8
Buckthorn	5	0	4.5
Birch	3	0	6.6
Spruce, lodgepole, larch	1 each	0	--
All species	917	1	

Campground units and riparian zone between 105A road and the river

This area includes trees on maps 1 through 24. Of the 702 trees in this area, 215 are within boundaries of the designated riparian area and 53 trees area dead.

Grand fir was by far the most abundant species (93 percent) evaluated (Table 2). Western redcedar and Douglas-fir (5 percent) comprised most of the remainder of the trees in the areas of interest. There were a few large Cascara buckthorn (Rhamnus purshiana DC) and birch, particularly in canopy openings caused by root disease. Several young western white pines also were found in these openings, though they were generally too small to be included in the assessment.

Table 2. Tree condition and average diameter at breast height by species of all trees evaluated in Weitas campground and surrounding area. (Based on July 2004 assessment.)

Species	Total	Avg. d.b.h.	Avg rrsv*	Dead
Grand fir	670	14.1	2.48	53
Western redcedar	3	9.4	0	0
Douglas-fir	13	11.8	1.15	0
Western white pine	5	14.8	0	0
Buckthorn	5	4.6	0	0
Birch	3	6.6	0	0
Spruce, lodgepole, larch	1 each	NA	0	0
All species	702	14.0	2.46	53

* Average root disease severity

Nearly all grand fir and Douglas-fir had detectable symptoms of root disease. Of 683 grand fir and Douglas-fir, 76 percent were recorded as having symptoms of root disease. The relative severity of symptoms varied greatly among trees from mild growth and crown density changes to complete morbidity. Young trees were proportionally less affected, as were trees in the riparian zone nearest the river. Only five Douglas-fir were outside of the riparian zone; these were all rated 2 or higher for root disease symptoms.

Other significant damages included wounds, which were mostly human-caused, and stem decay (Table 3). Leans, dead tops and stem cankers were recorded for a few trees. Although sometimes severe, wounding and stem decay were seldom a primary cause for recommending tree removal.

Table 3. Proportion of fully evaluated trees with moderate to severe damages or defects. (Based on July 2004 assessment.

Species	Root Disease			Wounds			Stem decay			Other Damages
Severity	2	3	4	2	3	4	2	3	4	3 or 4
Grand fir	.33	.46	.10	.15	.19	.02	.04	.03	.02	.05
Douglas-fir	.23	.23	.08				.08			.08
Western redcedar								.33		
Western white pine					.33			.33		.33

Hazard trees, by definition, pose a physical hazard to a known target. Targets are classes according to likelihood that a person, personal property or a physical improvement (such as table or outhouse) will be struck by a failing tree. Weitas campground was evaluated in part on the basis of known targets such as the existing fire rings and tables and in part with the expectation that many non-designated locations within the general camping area may be occupied.

High hazard ratings in Weitas were mostly based on probability of imminent tree death. Trees with root disease severities of 3 or 4 were already dead or considered near-death.

Such trees are also more likely to fail than those with less severe crown symptoms because they generally will have more extensive root and butt decay. Even trees with relatively mild crown symptoms may have enough root decay to cause tree failure under the right circumstances. Wind and soil conditions can contribute to unpredictable failures.

Many trees that would otherwise be removed as hazard trees were recommended for retention in the riparian zone with the intention of moving some of the campsite further away from the river to reduce the hazard without removing riparian trees. Therefore most trees recommended for removal were in the camping area above the riparian zone (Table 4).

Table 4. Live tree damages and recommendations inside and outside riparian zone.

Area	Campsite					Riparian				
	Total Live	Root* disease	Other* damage	Removal Recommended		Total Live	Root* disease	Other* damages	Removal Recommended	
				Trees	%				Trees	%
Upstream**	128	55	35	86	67	121	NA	NA	5	4
Units 1-3	227	110	58	119	52	66	27	7	6	22
Units 4-6	85	54	18	51	60	22	7	1	0	0
Total	440	219	111	256	58	209	NA	NA	11	5

*Damage rated severity level 3 or greater.

** Upsteam from Weitas Cr. bridge on the North Fork of the Clearwater River. See the map (Figure 2)..

In general, trees recommended for removal were similar to, or slightly smaller than those to be retained (Table 5). Dead trees were recommended for removal unless they were in the riparian zone and did not pose a hazard to adjacent campsites. Mortality was heaviest in the upstream portion of the campground where root disease is particularly active.

Most of the trees recommended for removal were, of course, grand fir. The diameter classes of trees marked for removal in the areas below the 105A road are included in Table 6. We recorded only retention trees in the adjacent zone above the 105A road.

Table 5. Size and condition of trees based on management recommendation (Retention or removal.) (July 2004 assessment.)

	Retention			Removal		
Location	Live	Dead	Avg. dbh	Live	Dead	Avg. dbh
Upstream*	184	0	14.0	65	21	14.0
Units 1-3	168	0	14.2	125	24	12.7
Units 4-6	56	0	15.9	51	8	14.7
All campground areas	408	0	14.3	241	53	13.5
Adjacent Zone**	215	0	16.5	NA	NA	NA
All areas	622	0	15.1	NA	NA	NA

*Upsteam from Weitas Cr. bridge on the North Fork of the Clearwater River. See the map (Figure 2).

** 150 ft. zone above main road in which tree failure could result in trees striking road.

Table 6. Number of recommended removals by diameter class. (Based on July 2004 assessment.)

	Diameter classes (inches at breast height)						
Species	8-11.9	12-15.9	16-19.9	20-23.9	24-27.9	Max. dbh	Total
Grand fir	93	104	57	15	3	27.3	292
White pine			1			19.1	1
Douglas-fir					1	24.3	1

Adjacent Zone above 105A road

Root disease was also very active in the 150 ft. zone above the 105A road. Here, we measured and evaluated the current root disease symptoms of only trees not marked for removal. Like the rest of the campground, grand fir makes up most of this stand. They are relatively larger trees and root disease a little more active up in this area than in the most of the campground (Table 7). For the most part, the marking previously completed accurately identified the trees most likely to die in the near future. Some adjustments were made. A few more western redcedar trees were found in this stand and they tended to be larger than those found in the camping units.

			Diameter at breast height		
Species	Trees	Avg. Root Disease	Min.	Max.	Avg.
Grand fir	185	1.7	4.9	31.3	17.5
Douglas-fir	5	2.2	6.1	19.0	11.5
Western redcedar	25	0	5.2	18.5	10.3
All species	215	1.5	4.9	31.3	16.5

Table 7. Trees intended for retention in the hazard tree removal area in the Adjacent Zone above the 105 A road.

MANAGEMENT RECOMMENDATIONS

Removal of highest hazard trees before campground is occupied

These trees were mostly grand fir that, if they failed, would have tent or parking sites, tables, or fire pits as likely targets. They are trees that lean, show root heaving, or have heaviest crowns in the direction of one of these targets. Such trees have higher risk of causing property damage or injury in the case of failure. All trees have some risk of failure and trees with root disease are at an increased risk because of decay of structural roots. It is common practice in campground maintenance to remove trees with indicators of hazard (such as root disease or stem decay) with priority given to trees with human-inhabited targets.

Additional mortality should be anticipated as the disease continues to progress in remaining grand fir (Table 8). Thinning will not improve the condition of the grand fir trees. Annual evaluation of the site and removal of dead or dying trees is likely to be required. Revegetation with species resistant to S-type annosus and Armillaria root diseases will be necessary to re-establish tree cover and restore the aesthetic qualities of the site.

Table 8. Root disease severity detail for grand fir in Weitas Campground that are expected to remain following hazard tree removal in 2004-5.

Area	Root Disease Severity	Trees	Average dbh
Above 105A	0	1	13.1
	1	66	18.3
	2	99	17.5
	3	19	14.9
Camping area	0	27	8.7
	1	22	20.5
	2	124	17.0
	3	37	12.0
Riparian zone	0	26	10.0
	1	2	24.5
	2	20	16.7
	3	28	14.0
	N*	122	12.9
* Root disease severity was not evaluated.			

Monitoring all trees

A walk-through exam including reassessment of trees previously noted as needing monitoring should be done each year. A thorough assessment should occur about every 5 years, at which time the database and maps should be updated. Conditions are expected to continue to deteriorate in this campground with considerable mortality, particularly in grand fir, following the disturbances related to campground renovation.

A vegetation management plan

A comprehensive vegetation management plan should be developed for this campground. Cedar and white pine regeneration is present in small amounts but most of the small trees are grand fir and Douglas-fir which are not expected to survive to maturity. Root disease may expand in response to hazard tree removal and tree removals necessitated by campground renovation. Douglas-fir, and grand fir are highly susceptible (particularly Douglas-fir) and should be minimized in the target vegetation. Western redcedar, western white pine and western larch are resistant (though not immune) to most root pathogens and are likely suitable species for this site. Native hardwood trees and shrubs are immune to annosus root disease.

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Annosus root disease biology and management

There are two types of Heterobasidion annosum in Idaho that are distinguished on the basis of host range. The P-type, which causes its greatest damage in ponderosa pine, appears to be far less common in Idaho than the S-type. S-type, named for it's significance as a pathogen of spruce species in Europe, is a very common and damaging pathogen of Douglas-fir, grand fir and subalpine fir in Idaho. Western redcedar is also a common host to H. annosum, though it seems to survive infections for many decades. Although we have not determined whether western redcedar is host to P-type or S-type, it is most likely to be S-type based the presence of root disease in Douglas-fir and grand fir growing in association with infected cedar. Pines, western larch and hardwoods are resistant to S-type H. annosum.

The disease, as the name implies, mostly involves the roots. The fungus attacks the root cambium, girdling and killing roots. Once dead, the roots are decayed by H. annosum. The disease spreads throughout root systems and the fungus moves from tree to tree through root contacts and for short distances through soil or duff. In general, the disease kills Douglas-fir more rapidly than grand or subalpine firs. Thus, by the time grand or subalpine firs are visibly declining, the Douglas-fir component of stands has already been killed. Once established on a site the fungus is essentially a permanent feature of the site. They are long-lived organisms that can take advantage of the presence of hosts from one generation of trees to the next. They survive forest fires by slowly decaying root systems well below ground.

Stump surface infection can be an important means of spread of P-type annosum so management recommendations often include treatment of stump surfaces to prevent spread of the disease. S-type annosum is does not provide this opportunity. High rates of root infection exist in most Douglas fir and grand firstands that render stump infection inconsequential. Partial harvest, leaving Douglas-fir, grand fir or subalpine fir is discouraged because high rates of mortality of leave-trees generally result. Mortality rates between 3 and 7 percent per year are common if apparently healthy Douglas-fir and true firs are left after harvest. (Rates are higher if symptomatic trees are left.)

Stem decay biology and management

Indian paint fungus, Echinodontium tinctorium and the white pocket rot, Phellinus pini, are thought to have similar biology. Infections are initially established in shade-killed branches. The fungus produces a "quiescent" infection in which it fails to progress much beyond the original point of establishment for some years. As the tree grows, the dead, infected branch stub is incorporated in the heartwood. Once surrounded by the no longer living, thereby no longer resistant, heartwood, the fungus begins to grow. It lives entirely by decaying the dead heartwood, never invading live sapwood.

Decay caused by E. tinctorium can be especially extensive. A single young E. tinctorium conk may indicate a decay column extending 8 feet above and 8 feet below the conk. Larger, older conks may indicate 20 feet below and 21 feet above the conk. Two or more conks, widely separated on the stem, probably indicate that virtually the full length of the stem has a central column of decay. The longer the column is, the greater the width of the decay column. Phellinus pini decay is generally considered more limited in extent, extending about 3 feet in either direction from a conk. However, there are often many conks scattered throughout the length of the stem.

Wounds that kill a patch of cambium are known to greatly accelerate the extent and perhaps the rate of decay caused by Indian paint fungus. It is thought the dead tissue, which essentially becomes a part of the heartwood by virtue of being dead, increases aeration of the heartwood and improves growing conditions for the fungus. Whatever the cause, wounds are a highly significant factor in predicting decay volumes in grand fir. Infected overstory grand fir with stagnated understory grand fir provides the ideal situation for development of Indian paint fungus infection.

Appendix B

INSTRUCTIONS: Find the description of defect that most closely describes an observed situation and enter the severity code on the evaluation form. If three or more defects of the same severity are recorded for a single tree (e.g., 3D, 3W, 3L), the overall severity rating for the tree may be increased by one level (column A on the evaluation form). Your situation may not be described or exactly fit a description; the descriptions are simply provided to assist you in assigning an appropriate severity level for each defect. **Dead trees are automatically assigned a severity of 4.**

SEV. Code	**DECAY OR CAVITY**: trees where significant decay is suspected should be increment bored to determine sound wood remaining (Rind) and excluding bark; severity may be influenced by tree species.
1D	Staining, including wet wood, or incipient decay, but no advanced decay or fruiting bodies, no cavities.
2D	Advanced decay or cavities observed; sound wood (rind) >60% of radius; may have unusual pitch or watery slime seeping from cracks or openings.
3D	Advanced decay or cavities observed; sound wood (rind) 60-30% of radius (excluding bark); fruiting bodies may be present.
4D	Advanced decay or cavities observed; sound wood (rind) < 30% of radius; numerous conks or fruiting bodies or other defects.
	STEM DAMAGE AND WOUNDS: Lightning, frost cracks, mechanical, animal, human
1W	Cracks or wounds of any size but well-calloused or superficial, no decay
2W	Minor structural damage involving <10% of circumference; small cracks, fire scars.
3W	Some structural damage and associated decay; 10-50% circumference; large fire scars; severe cracks extending through stem.
4W	Multiple cracks or wounds causing severe structural damage and associated decay in > 50% of circumference; or movement detected in major crack.
	CANKERS: Blister rust, gall rust, dwarf mistletoe, etc.
1C	< 10% of bole girdled; burls of any size
2C	10-30% of bole girdled
3C	30-75% of bole girdled
4C	>75% of bole girdled or associated with other defects.
	LEAN/SWEEP: growth at the very top of the tree may indicate how long a tree has been leaning.
1L	Natural long-term lean <10%, fully compensated by growth (top of tree is vertical for many years).
2L	Natural long-term lean 10-15 degrees, fully compensated by growth (top of tree is vertical for many years).
3L	Lean 15-20 degrees or some indication of root movement (soil mounding, etc.), or associated with a canker.
4L	Lean >20 degrees with evidence of failure (e.g., obvious recent soil movement, root wrenching); associated with decay or cracks.
	BRANCHES, FORKS, WITCHES BROOMS AND TOPS
1B	Small dead or hanging branches or dead top <"; small witches brooms.
2B	Large brooms, dead or hanging branches or dead top 3-5"; unbalanced canopy due to poor pruning or multiple tops; codominant stems with no included bark.
3B	Dead or broken branches or dead top 6-9"; large codominant stems with included bark (weak union).
4B	Dead or broken branches or dead top >9".
	ROOT DAMAGE, ROOT DISEASE
1R	Minor exposed roots, not sprung, no decay
2R	Exposed roots with minor damage or decay on small roots (<3"); no evidence of root disease.
3R	Substantial damage to roots >3" but <50% or root system affected; root disease suspected (slow growth, or other symptoms) but not obvious or confirmed.
4R	Exposed, decayed roots or substantial damage to roots >3" on >50% of root system; obvious root disease symptoms or signs (e.g., thinning, fading crown, stress cone crop, basal resinosus).